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A randomized controlled study of a computerized limited education program among young adults with asthma

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Summary The aim of the study was to assess the effectiveness of a computerized limited asthma education program, designed to suit young people.

The study was conducted with 97 young adults (18–25 years) with asthma, 48 were randomized to the intervention group and 49 to the control group, and they were followed for 12 months. The intervention group completed an interactive computer program of 30-min duration providing information about asthma, mechanisms, trigger factors, allergies and medication use, which was followed by a 30-min discussion with a specialized asthma nurse. The control group followed the routine schedule for asthma outpatients. The outcomes of the study were number of hospital admissions, emergency visits, asthma symptoms, knowledge about asthma, lung function and quality of life.

No effect was found regarding admission to hospital, emergency visits, prevalence of respiratory symptoms, knowledge of asthma or quality of life. However, forced exhaled volume in 1 s (FEV_1) increased significantly, mainly among the atopic subjects.

In conclusion, an intervention with a limited asthma education program did not show an effect on asthma symptoms, asthma knowledge or quality of life parameters.

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Introduction

Asthma prevalence is high, and likely increasing due to a growing incidence among children and teenagers. In the 16–19 year age group, the incidence may have a peak. Estimates of about 8/1000 person-years have been reported.[1] Hence, asthma among adolescents and young teenagers is a major public health issue. Even if the current anti-inflammatory therapy is effective, problems still exist with poor adherence to given advices, resulting in a suboptimal effect of prescribed treatments. One way to increase adherence to given advices is to improve knowledge about asthma, as together with attitudes and beliefs, knowledge is recognized as being a major determinant of health behaviour, including adherence.[2,3] A number of controlled trials have been published in which the effectiveness of different asthma education programmes was evaluated. Such programs can be designed to varying degrees of complexity, and they can also include different self-management components.

A common method is to use limited educational interventions, defined as a program that only transfers information about mechanisms of asthma, occurrence and action of trigger factors and side effects of medication. The program does not make any attempt to improve self-management skills or to modify medication.[4] The Cochrane Collaboration has evaluated the published studies on these limited educational interventions.[4,5] Twelve papers were evaluated and they indicated that limited asthma education programmes may reduce the prevalence of asthma symptoms, but that they did not improve lung function or reduce the number of hospitalizations or amount of asthma medications used. Whether the programs influenced the quality of life as an endpoint was not evaluated. All studies, except one, included a wide age range, and no study focused on adolescents or young adults. Young adults and adolescents often have poorly controlled asthma, and as a group, display low adherence regarding more extensive self-management approaches. Poor adherence to treatment guidelines has also been pointed out as a possible cause of death among adolescents with asthma.[6]

Thus, we decided to design a limited asthma education program with the aim of improving asthma control and quality of life in a group of young adults with asthma, and to assess the effectiveness of this simple program in a randomized controlled trial.

Methods

Subjects

The study was conducted at the asthma outpatient clinic of the Department of Allergology, Sahlgrenska University Hospital, Göteborg, Sweden. The study was approved by the Local Ethical Committee. Subjects were asthma patients between the ages of 18 and 25 who were referred to the special ''Asthma outpatient clinic for young adults'' during 1998. All patients were referred from the Children's Hospital at the University Hospital in Göteborg. Criteria for inclusion was asthma diagnosed by a paediatrician. The severity of asthma was classified according to the Global Initiative for Asthma GINA.[7]

The first 98 patients who met the inclusion criteria were invited to participate in the study and informed about its purpose and design. All patients agreed to participate and were randomly assigned to either active education (intervention group) or to normal care (control group) using the closed envelope technique. One patient was excluded due to social reasons, hence the study group comprised 97 subjects, 48 in the intervention group and 49 in the control group (Table 1).

Study design

All patients included in the trial were followed as outpatients in a special clinic for young adults. The clinic had an allergist (SE) and a specialist nurse (RS) and both groups in the trial were attended by the same team. Team visits took place in the afternoon when the patients were free from school or work, and all patients had the opportunity to contact the team by telephone if they had questions about symptom exacerbation, medication or anything else. The patients were followed for 12 months.

All subjects were investigated with skin prick test and spirometry (Vitalograph). The spirometries were performed by the RS. When assessing forced exhaled volume in 1 s (FEV_1), forced vital capacity (FVC) and FEV% percent of predicted value was used.[8] At baseline one subject (intervention group) failed to perform a spirometry, and in addition four subjects failed to complete an acceptable FVC manoeuvre (two from the intervention group and two from the control group). At follow-up one subject failed to perform a spirometry, and two subjects failed to complete an acceptable FVC manoeuvre, all were from the control group.

Table 1 Description of the included subjects at baseline.

	Intervention group ($n = 48$)	Control group ($n = 49$)
Females (%)	52	45
Age (yr)	18.3 (0.2)	18.5 (0.2)
Age of asthma onset (yr)	6.9 (0.8)	5.6 (0.8)
Severe asthma (%)	38	37
Moderate asthma (%)	57	60
Positive skin prick test (%)	91	85
Daily dose of inhaled steroids		
Budesonide (μg)	735	533
Fluticasonpropionat (μg)	583	633
Beclometasondipropionat (μg)	418	475
Never smokers (%)	63	76

The subjects are divided into intervention group and control group in a randomised controlled study of asthma education among adolescents. Standard error (SE) within brackets.

The intervention consisted of an interactive 30-min computer program based on "Teach Your Patients About Asthma: A Clinician Guide".[9] The program provided; (1) basic information about asthma; (2) information about medication use (bronchodilators and inhaled steroids), as well as how to use inhalers and peak flow meters; (3) information about asthma triggers, allergens and allergies.[10] The program was developed at the Department of Respiratory medicine and Allergology, and can be obtained on request from the corresponding author.

The program was constructed with different groups of asthma patients. Before the present study began, the finalized version was tested on 10 subjects with asthma. This pilot study resulted in only minor improvements to the program. The final program consisted of 30 questions with 3–6 alternative answers. Each question had an accompanying graphic that further illustrated the message. The subject was unable to proceed to the next question before the correct answer was given. After each question the patient also had feed-back about the answer. At the end of the program, the nurse led a structured discussion with each subject about his/her results. Discussions lasted approximately 30 min with each subject. Hence, altogether the intervention took 1 h.

The patients assigned to the intervention group completed the interactive computer program, and were then scheduled to visit the clinic team every sixth month, or according to individual needs. The control group followed the routine schedule of the outpatient clinic for young adults, in which the next follow-up took place after 6 months or as needed.

Outcome measures

All outcome measures (including the three questionnaires described below) were obtained from all subjects at the start of the study and after 12 months. The outcomes of the study were number of hospital admissions, unscheduled visits, asthma symptoms, knowledge about asthma, lung function and quality of life.

A self-administered questionnaire was constructed based on previous questionnaires.[11,12] It included 41 items, and the first part covered asthma symptoms over the last 3 months including nocturnal symptoms and their perceived disability due to asthma. The remaining items covered knowledge about triggers and physical activities (15 items), knowledge about asthma as a disease (6 items), how to use medications (11 items), its side effects (8 items) and finally one item about paramedical treatment.

The physician completed a structured questionnaire about patients' symptoms and status at the first visit and after 12 months. The questionnaire covered frequency of symptoms, hospital admissions and unscheduled visits. The symptoms were registered for the previous 4 weeks and the hospital admissions and unscheduled visits covered the previous 6 months.

Quality of life was assessed with the "Living with Asthma Questionnaire".[13,14] This questionnaire has been translated to Swedish and adapted to Swedish conditions.[15] The questionnaire includes 11 domains: (1) social and leisure activities; (2) sports; (3) holidays; (4) sleep; (5) work and other activities; (6) colds; (7) mobility; (8) effects on others; (9) medication usage; (10) sex; (11) dysphoric

states and attitudes. The subjects responded to the questionnaire on a three-point scale, untrue, slightly true and very true. There was also an alternative ''not applicable''. The quality of life was calculated according to Hyland[13] as the sum of the points in each item divided by the numbers of items in each area, i.e. the mean scores are calculated, and analyzed as continuous variables. The questionnaire was completed at the start of the study and at follow-up 12 months later.

Statistical analyses

The SAS statistical package (version 8.0) was used for the analyses. In general, the results were analyzed (for each subject) as the difference between follow-up and the start of study, and the *P*-values have been written. For continuous variables such as lung function and quality of life the mean values of the difference at baseline and at follow-up for the intervention group and control group, respectively, were calculated and the statistical significances were analyzed with a non-parametric test (Kruskall–Wallis). The categorical variables were analyzed as the fraction of subjects in each group showing an improvement, and the statistical significance was analyzed with a chi-square based method. Lung function values and quality of life outcomes were also analyzed using multiple linear regression models (PROC GLM). The dependent variables in the quality of life models were logarithm transformed, and the independent variables were intervention (yes/no), atopy, age, sex and asthma severity. For lung function the models also included smoking habits and the baseline value of FEV_1. The appropriate sample size was calculated based on the standardized difference for categorical data as described by Altman.[16]

Results

Table 1 shows the basic data of the subjects included in the study. The groups were similar with regard to age, asthma severity, daily dose of inhaled steroids, smoking and sex distribution. All subjects completed the study.

During the follow-up period one patient in the intervention group was admitted to hospital and 17 had unscheduled visits, compared to one and 16, respectively, in the control group. In the intervention group 47 subjects used inhaled steroids, both before and after the intervention, and only one subject increased the dose. Regarding long-acting β_2-agonists 17 subjects used them before and 16 used them after the intervention, with no changed in the prescribed dosages. Among the controls the pattern was similar, 46 subjects used inhaled steroids before the study and 47 subjects used them after the intervention. Twenty subjects used long-acting β_2-agonists before the intervention and 17 used them after the intervention. None was chronic user of oral steroids. After the intervention there was a slightly decreased severity of asthma in both groups.

Based on the physician''s questionnaire, the prevalence of nocturnal and diurnal respiratory symptoms decreased in both the intervention and control group (Table 2). When the decrease in the control group was controlled, there was no statistically significant effect of the intervention.

After intervention FEV_1 increased significantly in the intervention group compared to the controls (Table 3). The improved FEV_1 was observed mainly among the atopic subjects. FVC did not show any statistically significant changes during the follow-up period. The improvement in FEV_1 in the intervention group was significant (estimate 3.8%, $P = 0.02$) in a multiple linear regression model adjusting for age, sex, skin prick test, smoking habits and baseline value of FEV_1.

Based on the self-administered questionnaire, the prevalence of asthma symptoms decreased both among the intervention group and the controls, resulting in no significant differences. The same occurred for the knowledge about asthma, which increased among both the intervention subjects and the controls, as did knowledge about asthma triggers. If we assume that the prevalence of asthma symptoms will decrease with 20% in the intervention group compared to zero among controls, then we need to have 40 subjects in each group to detect such an effect with an 85% probability and at the 5% significance level. The underlying meaning of this is, that if an effect really exists, it would have been detected. The only change (out of 41 items) that was statistically significant was a decreased positive response to the question ''Do you know what asthma is?'' This decreased from 81% to 73% in the intervention group, and increase from 84% to 94% among the controls ($P = 0.02$).

The intervention did not result in any statistically significant changes in quality of life parameters, as quality of life increased in both groups (Table 4). The negative results remained when the data were analyzed in a multiple linear regression model adjusting for atopy, asthma severity, age, sex and educational level. The results were similar when analyzed separately for different groups of asthma severity.

Table 2 Prevalence of subjects with respiratory symptoms in the intervention group and control group at baseline and after 1 year.

	Intervention group ($n = 48$)	Control group ($n = 49$)	P-value
Nocturnal wheezing			
Baseline	7/48	8/49	>0.5
After 1 year	3/48	2/49	>0.5
Nocturnal dyspnoea			
Baseline	12/48	12/49	>0.5
After 1 year	4/48	2/49	0.3
Nocturnal cough			
Baseline	8/48	6/49	0.4
After 1 year	4/48	1/49	0.1
Wheezing			
Baseline	17/48	15/49	>0.5
After 1 year	2/48	2/49	>0.5
Dyspnoea			
Baseline	30/48	27/49	0.4
After 1 year	5/48	4/49	>0.5
Cough			
Baseline	13/48	14/49	>0.5
After 1 year	3/48	2/49	>0.5

Data from a randomized controlled study of asthma education among adolescents. Based on information from a physicians interview.

Table 3 Lung function in the intervention group and control group at baseline and after 1 year.

		Intervention group (% pred.*)	Control group (% pred.*)	P-value†
All subjects				
FEV_1	Baseline	89.1 (2.1), $n = 47$	92.3 (1.8), $n = 49$	0.18
	Follow-up	92.9 (1.7), $n = 48$	92.1 (1.8), $n = 48$	0.57
	Change (follow-up−baseline)	4.0 (1.5), $n = 47$	−0.55 (0.8), $n = 48$	0.01
FVC	Baseline	95.4 (1.7), $n = 45$	96.0 (1.6), $n = 47$	0.64
	Follow-up	97.0 (1.7), $n = 48$	96.4 (1.7), $n = 46$	0.80
	Change (follow-up−baseline)	2.0 (1.2), $n = 45$	0.26 (1.0), $n = 46$	0.19
Subjects with positive skin prick test				
FEV_1	Baseline	89.2 (2.2), $n = 42$	93.0 (1.5), $n = 39$	0.22
	After 1 year	93.3 (1.7), $n = 43$	93.2 (1.4), $n = 39$	0.69
	Change (follow-up−baseline)	4.4 (0.18), $n = 42$	0.18 (0.82), $n = 39$	0.04
FVC	Baseline	95.1 (1.9), $n = 40$	96.9 (1.7), $n = 38$	0.41
	After 1 year	96.7 (1.8), $n = 43$	98.2 (1.5), $n = 38$	0.38
	Change (follow-up−baseline)	2.1 (1.3), $n = 40$	1.3 (1.0), $n = 38$	>0.5
Subjects with negative skin prick tests				
FEV_1	Baseline	88.7 (7.1), $n = 5$	89.6 (6.5), $n = 10$	0.62
	After 1 year	88.9 (6.4), $n = 4$	87.8 (7.5), $n = 7$	0.32
	Change (follow-up−baseline)	0.25 (2.8), $n = 5$	−3.7 (1.6), $n = 9$	0.16
FVC	Baseline	97.9 (5.4), $n = 5$	92.2 (4.3), $n = 9$	0.64
	After 1 year	99.6 (5.0), $n = 5$	87.5 (6.2), $n = 8$	0.24
	Change (follow-up−baseline)	1.8 (1.6), $n = 5$	−5.5 (2.7), $n = 7$	0.06

Data from a randomized controlled study of asthma education among adolescents. Standard error (SE) within brackets.
*Pred. = predicted (see Knudson et al. [8]).
†Kruskall–Wallis.

Table 4 Quality of life parameters in the intervention group and control group at baseline and after 1 year.

	Intervention before	Control before	Intervention after	Control after	*P*-value*
Overall score	153.2 (4.7)	161.8 (3.6)	163.6 (4.2)	166.2 (4.0)	>0.5
Social and leisure activities	2.5 (0.08)	2.5 (0.07)	2.6 (0.07)	2.6 (0.07)	>0.5
Sports	2.6 (0.08)	2.7 (0.08)	2.7 (0.07)	2.7 (0.07)	0.38
Holidays	2.5 (0.07)	2.5 (0.08)	2.6 (0.07)	2.5 (0.08)	0.23
Sleep	2.7 (0.07)	2.7 (0.05)	2.8 (0.05)	2.8 (0.05)	>0.5
Work	2.4 (0.07)	2.5 (0.08)	2.5 (0.06)	2.6 (0.07)	0.34
Colds	2.2 (0.08)	2.2 (0.07)	2.3 (0.07)	2.3 (0.07)	0.49
Mobility	2.6 (0.06)	2.6 (0.05)	2.7 (0.08)	2.7 (0.07)	0.09
Effects on others	2.5 (0.07)	2.6 (0.06)	2.6 (0.04)	2.6 (0.05)	>0.5
Medication usage	2.3 (0.07)	2.5 (0.05)	2.4 (0.05)	2.5 (0.06)	>0.5
Sex	3.0 (0.03)	2.8 (0.07)	3.0 (0.03)	2.9 (0.05)	0.19
Dysphoric states and attitudes	2.6 (0.06)	2.6 (0.06)	2.7 (0.04)	2.7 (0.05)	>0.5

Data from a randomized controlled study of asthma education among adolescents. Standard error (SE) within brackets.
*Kruskall–Wallis.

Discussion

The computer-supported limited education program evaluated in this study was found to be without effect regarding admittance to hospital, emergency department visits, prevalence of respiratory symptoms, knowledge of asthma or quality of life. However, the educational program seems to be associated with a significant improvement in FEV_1.

There are certain possible sources of bias that have to be discussed. The blinding of the study was not complete, as the same nurse conducted the interactive education sessions and later on saw the subjects in the specialist outpatient clinic. There is a possibility that the nurse could recall the group assignment of some subjects, hence, this may have introduced some bias during the follow-up period. This could also cause some contamination of the control group, which may explain the lack of intervention effect.

Subjects in the intervention group did not experience a significant reduction of asthma symptoms the last 4 weeks as compared to the controls. We are, however, not able to analyze if there were any differences between the groups in the daily frequency of symptoms. Subjects in the intervention group could be experiencing cough or wheeze once a week, whereas those in the control group could be experiencing such symptoms daily.

According to previous studies, there are conflicting data whether limited asthma education has any effect on asthma morbidity, asthma knowledge or on the quality of life. The Cochrane Collaboration concluded that limited asthma education does not improve the health outcomes in adults with asthma.[4,5] However, in the reviewed studies there was, however, a slight improvement in reported symptoms, but no effect regarding more objective outcomes such as number of days with limited activity due to asthma. These mainly negative results are in line with the results from our study. Our lung function results are discussed below.

After this review two additional studies have been published.[17,18] An Italian study[17] found a slight improvement in quality of life among patients who participated in an asthma education program. There was no effect regarding other morbidity outcomes. The duration of the program was 6 h, divided into three sessions. There was, however, no interactive component in it, and the program was not computer-based. The follow-up period was 3 months. The population was older and less atopic compared to the subjects in our study. The most pronounced effects were also found among those with the most severe asthma.

In a Canadian study, a limited asthma education program was tested on 62 adolescents with asthma.[18] The education program was interactive, but not computer based. The duration was $1\frac{1}{2}-2$ h and the follow-up period was 6 months. They found that asthma education caused an improvement in both the intervention group and control group regarding emergency department visits and the occurrence of certain asthma symptoms. Some quality of life parameters were higher in the intervention group after the intervention. However, it is unclear whether this finding is an effect of the intervention as the authors have not analyzed it in relation to the baseline values.

Hence, our data does not indicate that limited asthma education has any effect on asthma

symptoms, asthma knowledge or quality of life. The reason for our negative findings could be that the education program was too short. In the Italian study, where an effect was found, the program was 6 h long.[17] The absence of an effect may also be the result of a long follow-up period. However, the negative studies have varying length of follow-up, from 3 months to several years. Thus, we do not think that we have missed a transient intervention effect.

However, these patients were referred to a recently started asthma outpatient clinic for young adults. Any intervention effect may have been lost in the over-riding of the general management and active care in this set-up. It may have been better to test the intervention in relation to a non-specialist treatment. In addition, also the fact that the patients were referred to a new clinic (from the Children's Hospital) may also have increased the compliance in both the intervention and control groups.

Regarding the present study, it should be emphasized that only minor changes were made to the prescribed medications during the follow-up period. The external validity of the results in our study could not be extrapolated to patients in general with asthma, as the population was recruited from a specialist clinic.

The computerized limited education program evaluated in this study was associated with an improved FEV_1. In the intervention group FEV_1 improved from 89.1% to 92.9% of the predicted value, and the controls remained unchanged around 92%. The improvement of FEV_1 was significant in a multiple linear regression model controlling for baseline value of FEV_1. It is, however, possible that in the present study the subjects allocated to the intervention group by chance have performed lower FEV_1 and therefore also have the greatest potential for improving. In the Cochrane report about limited asthma education, lung function was reported in two of the included papers.[18,19] In those papers, the interventions did not seem to alter lung function.

Limited asthma education is appealing in several ways, as it is easy to implement, can be readily adapted in a busy medical practice and it is also cheap. However, this study and most previously published studies have only shown small or marginal effects on the health outcomes, particularly compared to asthma self-management programmes.[4]

In conclusion, an intervention with a limited asthma education program did not show an effect on asthma symptoms, asthma knowledge or quality of life parameters.

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